Simultaneous Bilateral Vertebral Artery 3D Rotational Angiography

Technical Report of Two Cases

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Summary

We describe the first reported use of simultaneous bilateral vertebral artery rotational angiography to visualize an aneurysm.

Images acquired from 3D rotational angiography with a single vertebral injection provided insufficient anatomic detail in two cases with vertebrobasilar junction aneurysms associated with fenestration. Therefore, simultaneous bilateral vertebral artery 3D rotational runs were performed.

Anatomic detail was superior with the simultaneous injection and this allowed for the appropriate plan of care to be instituted. In the rare cases of vertebrobasilar junction aneurysm associated with fenestration, simultaneous bilateral vertebral artery 3D rotational angiography may provide the most useful anatomic detail when evaluating a patient for possible endovascular intervention.

Introduction

Development of 3D rotational cerebral angiography has resulted in a new standard of care in the treatment of aneurysms. The technology has improved anatomic detail and allows efficient detection of the optimal working view for intervention, potentially offering safer treatment of aneurysms [1-15].

We present two cases that necessitated bilateral vertebral artery 3D rotational angiography, a technique that has not been described in the literature.

Case Presentation

Case 1

A 64-year-old right-handed female was referred to neurovascular clinic after an incidental finding of an intracranial aneurysm. The patient was recently evaluated by an ophthalmologist and had an MRI and MRA performed after drusen bodies were found on ophthalmologic examination. At presentation, the patient was asymptomatic and neurologically intact. Review of the MRA showed an aneurysm at the vertebrobasilar junction, but the low quality of the study prevented determination of whether the aneurysm was fusiform or saccular. The patient agreed to catheter angiographic imaging with potential endovascular intervention.

We performed catheter angiography of the vertebral arteries in the standard fashion. A 5F catheter was used to selectively catheterize the origin of the vertebral artery and advance approximately 2-3 cm distal to the origin. In both of our cases tortuosity of the vessel limited further advancement. Contrast was hand-injected (5 ml) in a bolus over a 1-2 second duration. Initial angiography of the right vertebral artery

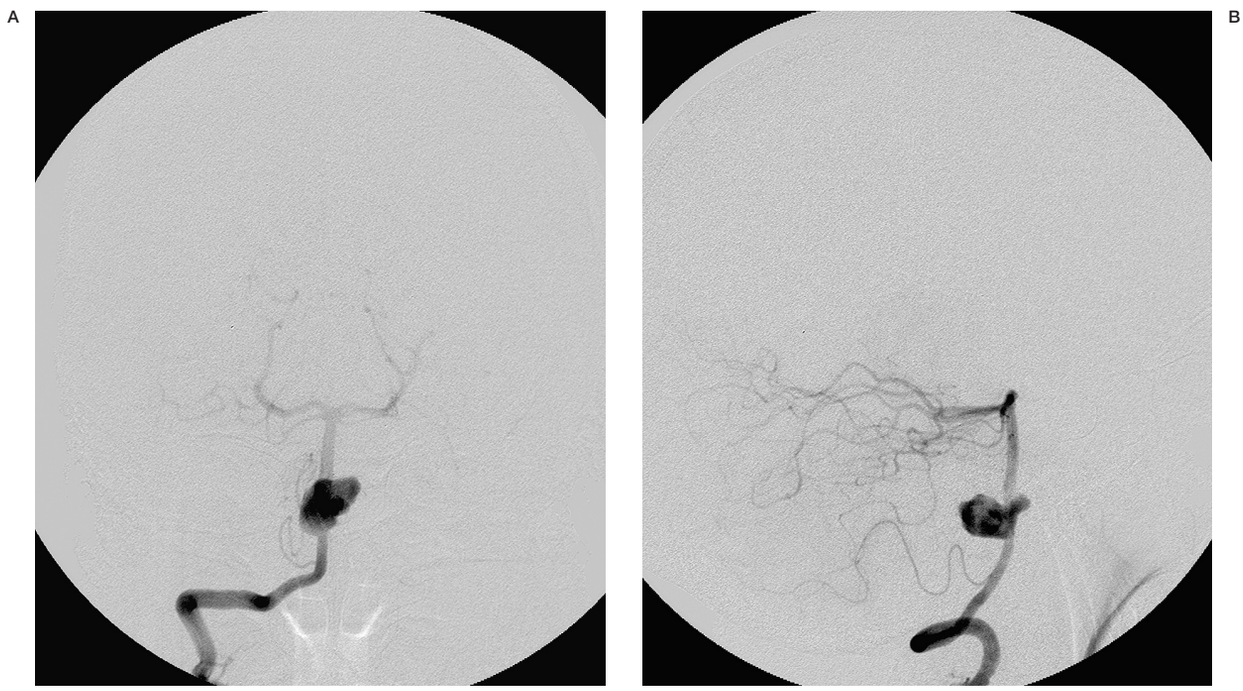

Figure 1 Case 1. Right vertebral artery angiogram showing an AP (A) view demonstrating an apparent fusiform aneurysm and a lateral (B) view depicting the daughter aneurysm.

Figure 2 Case 1. AP view of a left vertebral artery 3D rotational angiogram demonstrating filling of the vertebrobasilar junction aneurysm from the left as well as a distinct distal limb of the artery. Note the mid-basilar origin of the right posterior inferior cerebellar artery from this view.

(figure 1A) shows a fusiform aneurysm measuring 16 x 20 mm and an apparent daughter aneurysm (figure 1B) measuring 5 x 4 mm. 3D rotational angiography of the left vertebral artery (figure 2) shows contrast entering the aneurysm with a distinct separate distal limb of the artery, suggesting that the aneurysm arises from a proximal fenestration (Toshiba Infinix VCi, Nasu, Japan). Neither view allowed complete visualization of the aneurysm and the associated anatomy, thereby preventing safe endovascular intervention.

Subsequently, we decided to proceed with simultaneous bilateral vertebral artery 3D rotational angiography (figure 3A and 3B). Bilateral percutaneous femoral artery access was obtained and separate catheters were placed into each vertebral artery. Neither catheter was occlusive. Both catheters were connected to power injectors, one activated at the terminal with an injection of 3 ml/s for seven seconds and the other activated by manual trigger with an injection of 3 ml/s for seven seconds. Reconstructed 3D images (Vital Images Vitrea 2 Workstation, Fernbrook, Minnesota) clearly showed the aneurysm, the fenestration, and relation between the two. As shown in figures 3A

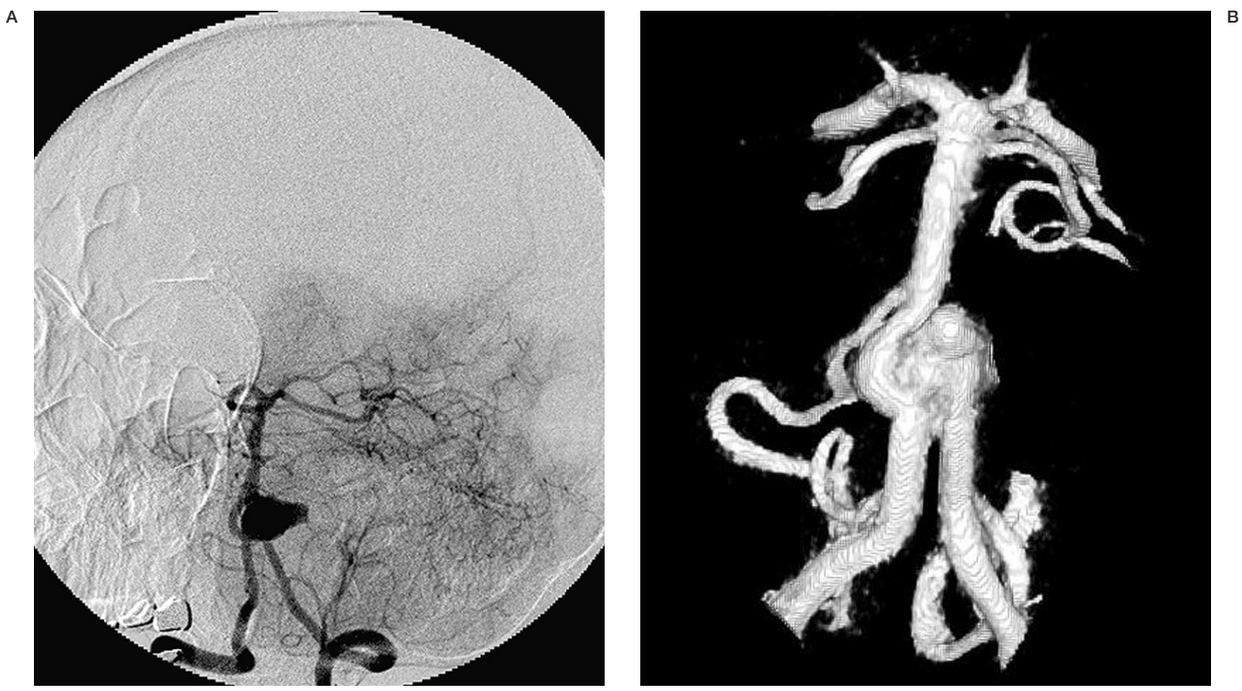

Figure 3 Case 1. Simultaneous bilateral vertebral 3D rotational angiogram (A) and reconstruction (B) demonstrating the complete anatomic picture of the vertebrobasilar junction aneurysm arising from the proximal portion of a basilar artery fenestration. Note the unusual duplicated origin of the right posterior inferior cerebellar artery.

and 3B, the aneurysm was not fusiform, but in fact arose from a proximal fenestration of the basilar artery. The additional information allowed for safe catheterization of the aneurysm from the left vertebral artery. The aneurysm was successfully embolized, however, at the end of the intervention it was noted that there was still residual filling of the aneurysm from the right vertebral artery. Interestingly, the patient had an unusual vertebral and mid-basilar duplicated origin of the posterior inferior cerebellar artery (best shown in figure 3B), a rare variant described in literature [16-18]. The duplicated origin of the posterior inferior cerebellar artery enabled the proximal right vertebral artery to be occluded without incident and subsequently the aneurysm no longer filled with contrast. The patient recovered without incident and was discharged home the following day.

Case 2

A 42-year-old right-handed female was seen in consultation. Six weeks prior, the patient had an episode of syncope, confusion, and transient right hemiparesis. She fully recovered and had an MRI and MRA performed on an outpatient basis. On examination, the patient was neurologically intact. Review of the MRA (figure 4) showed an aneurysm arising from the confluence of the vertebral arteries. The decision was made to explore the aneurysm with endovascular therapy.

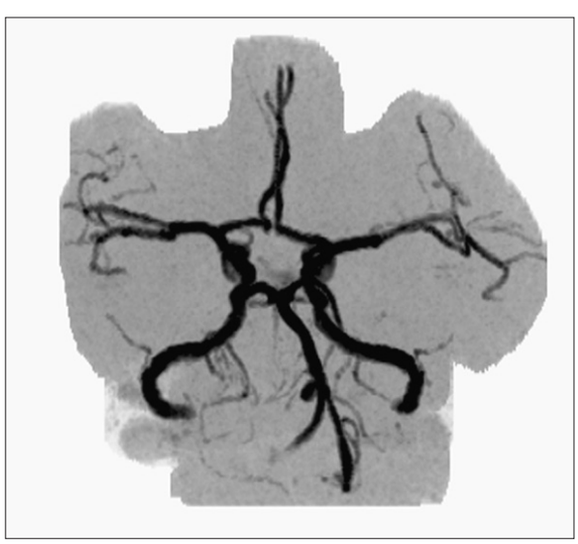

Figure 4 Case 2. MRA showing a vertebrobasilar junction aneurysm. Visualization of the fenestration is not seen.

Figure 5 Case 2. Posterior view of the left vertebral artery 3D rotational angiogram (A) and reconstruction (B) showing the vertebrobasilar aneurysm but not the fenestration.

In the neurointerventional suite, angiography of the right vertebral artery failed to demonstrate the aneurysm. We performed 3D rotational angiography by injection of contrast medium into the left vertebral artery. Images acquired from this run showed the aneurysm and an apparent small neck (figure 5A and B). Upon attempted catheterization of the aneurysm,

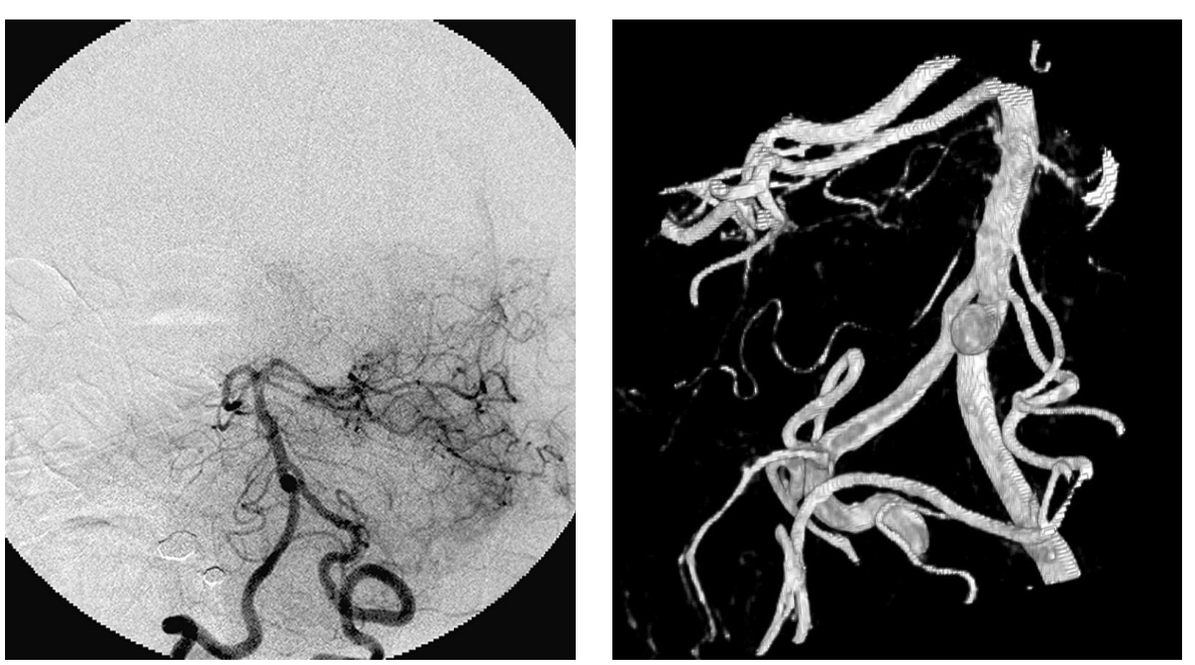

Figure 6 Case 2. Posterior view of the simultaneous bilateral vertebral artery 3D rotational angiogram (A) and reconstruction (B) which clearly shows the anatomic detail of the vertebrobasilar junction aneurysm and the associated basilar fenestration.

the tip migrated into the limb of a fenestration not visualized by the 3D angiography. Because of the inadequate anatomic detail, we aborted further intervention.

At that point, we decided to perform simultaneous bilateral vertebral artery 3D rotational angiography (figure 6A) by the technique described in the first case. Reconstructed images (figure 6B) show a vertebrobasilar aneurysm arising from the proximal limb of a basilar fenestration. The additional information allowed safe catheterization of the aneurysm, however, coil embolization of the aneurysm was unsuccessful secondary to a wide neck. After discussion with the patient, she opted for craniotomy and clipping of the aneurysm in favor of stent-assisted embolization. A far lateral craniotomy was performed and the patient was discharged home two days later without any adverse sequelae.

Discussion

3D rotational digital subtraction angiography is becoming the gold standard when preparing for endovascular intervention. The anatomic detail rendered by this method facilitates choosing the appropriate working view, and may ultimately lead to safer aneurysm coiling [1-15]. In most cases, single vessel injection for 3D rotational angiography is adequate. However, at least one case in literature describes how bilateral vessel injection was necessary for adequate anatomic detail. In their technical note, Song et Al describe simultaneous bilateral internal carotid artery 3D rotational angiography for a patient with both a complex, ruptured anterior communicating artery aneurysm and vasospasm [3].

To our knowledge, these two cases are the first report describing simultaneous bilateral vertebral artery 3D rotational angiography. Interestingly, MRA failed to depict the true anatomy associated with both vertebrobasilar junction aneurysms. Our failure to see the aneurysm and fenestration from a single vertebral artery was certainly a result of the flow phenomenon at the confluence of the vertebral arteries. In our patients, the vertebral arteries were nearly codominant. One can imagine that both the aneurysm and the fenestration would be seen in either of our patients if a dominant vertebral artery was present.

The risk of bilateral vertebral artery catheterization is unknown, however, would certainly be higher than single vessel injection. Some of these risks may include dissection, thromboembolic event, and rupture of the aneurysm. In our patients, neither catheter was occlusive and we would not recommend this technique if one or both of the catheters were occlusive as the risk of complication would be greater. One possible alternative to our technique is temporary occlusion of one vertebral artery with a balloon and injection of the contralateral vertebral artery.

Conclusions

Simultaneous bilateral vertebral artery 3D rotational angiography may provide the most useful anatomic detail when preparing for an endovascular intervention, particularly for complex aneurysms of the vertebrobasilar junction.

References

1 Sugahara T, Korogi Y et Al: Comparison of 2D and 3D digital subtraction angiography in evaluation of intracranial aneurysms. Am J Neuroradiol 23: 1545-1552, 2002.
2 Kang HS, Han MH et Al: Postoperative 3D angiography in intracranial aneurysms. Am J Neuroradiol 25: 1463-1469, 2004.
3 Song JK, Niimi Y et Al: Simultaneous bilateral internal carotid artery 3D rotational angiography. Am J Neuroradiol 25: 1787-1789, 2004.
4 Hochmuth A, Spetzger U, Schumacher M: Comparison of three-dimensional rotational angiography with digital subtraction angiography in the assessment of ruptured cerebral aneurysms. Am J Neuroradiol 23: 1199-1205, 2002.
5 Hirai T, Korogi Y et Al: Clinical usefulness of unsubtracted 3D digital angiography compared with rotational digital angiography in the pretreatment evaluation of intracranial aneurysms. Am J Neuroradiol 24: 1067-1074, 2003.
6 Heautot JF, Chabert E et Al: Analysis of cerebrovascular diseases by a new 3-dimensional computerised X-ray angiography system. Neuroradiology 40: 203-209, 1998.
7 Gailloud P, Oishi S et Al: Three-dimensional digital angiography: new tool for simultaneous three-dimensional rendering of vascular and osseous information during rotational angiography. Am J Neuroradiol 25: 571-573, 2004.
8 Ernemann UU, Gronewaller E et Al: Influence of geometric and haemodynamic parameters on aneurysm visualization during three-dimensional rotational angiography: an in vitro study. Am J Neuroradiol 24: 597-603, 2003.
9 Anxionnat R, Bracard S et Al: Intracranial aneurysms: clinical value of 3D digital subtraction angiography in the therapeutic decision and endovascular treatment. Radiology 218: 799-808, 2001.
10 Abe T, Hirohata M et Al: Clinical benefits of rotational 3D angiography in endovascular treatment of ruptured cerebral aneurysm. Am J Neuroradiol 23: 686-688, 2002.
11 Tanoue S, Kiyosue H et Al: Three-dimensional reconstructed images after rotational angiography in the evaluation of intracranial aneurysms: surgical correlation. Neurosurgery 47: 866-871, 2000.
12 Yanaka K, Matsumaru Y et Al: Ruptured aneurysm of the ophthalmic artery trunk demonstrated by three-dimensional rotational angiography: case report. Neurosurgery 51:1066-1069; discussion 1069-1070, 2002.
13 Kiyosue H, Okahara M et Al: Detection of the residual lumen of intracranial aneurysms immediately after coil embolization by three-dimensional digital subtraction angiographic virtual endoscopic imaging. Neurosurgery 50: 476-484; discussion 484-485, 2002.
14 Albuquerque FC, Spetzler RF et Al: Effects of three-dimensional angiography on the coiling of cerebral aneurysms. Neurosurgery 51: 597-605; discussion 605-606, 2002.
15 Hoff DJ, Wallace MC et Al: Rotational angiography assessment of cerebral aneurysms. Am J Neuroradiol 15: 1945-1948, 1994.
16 Pasco A, Thouveny F et Al: Ruptured aneurysm on a double origin of the posterior inferior cerebellar artery: a pathological entity in an anatomical variation. Report of two cases and review of the literature. J Neurosurg 96: 127-131, 2002.
17 Lister JR, Rhoton AL Jr et Al: Microsurgical anatomy of the posterior inferior cerebellar artery. Neurosurgery 10: 170-199, 1982.
18 Lesley WS, Dalsania HJ. Double origin of the posterior inferior cerebellar artery. Am J Neuroradiol 25: 425-427, 2004.

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